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### (54) READER/WRITER FOR ID TAG

#### (57)Abstract:

PROBLEM TO BE SOLVED: To simplify a configuration that acquires tag information from an ID tag on the basis of a received signal from a plurality of receiving antennas. SOLUTION: An MPU 29 of a controller 27 outputs a transmission signal for power to a transmitting antenna 25 of a selected antenna. An ID tag 47 transmits tag information by receiving and operating the received transmission signal for power. The MPU 29 amplifies the received signal received by the receiving antenna of the selected antenna with an amplifier circuit 32 and then reads the tag information by making the received signal into binary form in a detection circuit 34. Here the MPU 29 sets an amplification factor of the amplifier circuit 32 according with the selected antenna and also sets a threshold in the circuit 34. Thus it is possible to appropriately perform amplification without being affected by noise even though receiving sensitivity or a received noise level is different in each antenna.

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### CLAIMS

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#### [Claim(s)]

[Claim 1] A reader writer for ID tags which is provided with the following and characterized by reading tag information in said ID tag where a widening rate of said receiving circuit is set up by said widening rate setting-out means.

Two or more receiving antennas which receive a signal from an ID tag.

A receiving circuit which widens an input signal which a receiving antenna selected among these receiving antennas received.

A widening rate decision means which asks for a widening rate of said receiving

circuit so that a signal level of an input signal from a receiving antenna selected in the state of the electric power supply to said ID tag may turn into the optimal receiving level.

A widening rate setting-out means to set up a widening rate of said receiving circuit become the widening rate which this widening rate decision means judged.

[Claim 2]A reader writer for ID tags which is provided with the following and characterized by reading tag information in said ID tag where reference level of said receiving circuit is set up by said reference level setting-out means.

Two or more receiving antennas which receive a signal from an ID tag.

A receiving circuit which carries out binarization by comparing with reference level an input signal which a receiving antenna selected among these receiving antennas received.

A receiving level judging means which asks for a receiving level of said receiving circuit in a non communication state with said ID tag.

A reference level setting-out means to ask for optimal reference level based on a receiving level for which this receiving level judging means asked.

[Claim 3]The reader writer for ID tags according to claim 2 provided with a reference level verifying means which checks reference level set up by said reference level setting-out means.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the reader writer for ID tags for reading the ID information from an ID tag.

[0002]

[Description of the Prior Art]Drawing 15 shows an example of this kind of antenna control device. In this drawing 15two or more antennassuch as the large-sized antenna 1the medium size antenna 2the small antenna 3and the flabellate antenna 4are installed in the shelf which is not illustratedand each antennas 1-4 are connected with the reader writer 5 for ID tags in the state where it was connected mutually. These antennas 1-4 contain a transmission antenna and a receiving antennaand are constitutedand the antenna with the selected reader writer 5 for ID tags operates.

[0003]The receiving circuits 6-9 corresponding to a receiving antenna are established in the reader writer 5 for ID tagsrespectivelyand MPU10The input signal from the ID tag located on the antenna 1-4 is received by switching each receiving circuits 6-9 in

order according to turning on and off of the switches 11a-11h.

[0004] In this case the widening rate of each receiving circuits 6-9 is set up according to the characteristic of the receiving antennas 1-4. When "10" levels are required as a signal level of an input signal and the receiving level of the large-sized antenna 1 is "1" in the decoder 11 specifically the widening rate of the receiving circuit 6 for large-sized antenna 1 is set up 10 times. When the receiving level of the medium size antenna 2 is "2" the widening rate of the receiving circuit 7 for medium size antennas is set up 5 times. When the receiving level of the small antenna 3 is "5" the widening rate of the receiving circuit 8 for small antennas is set up twice. And when the receiving level of the flabellate antenna 4 is "3" the widening rate of the receiving circuit 9 for flabellate antennas is set up 3.3 times.

[0005] And MPU10 can acquire the tag information which was analyzed as tag information in the decoder 12 after binarization of the input signal was carried out in each receiving circuits 6-9 made it Mr. \*\* and was analyzed.

[0006] On the other hand drawing 16 shows the example from which the above-mentioned receiving antenna differs in composition. In this drawing 16 to the transmission antenna which is not illustrated the antenna 13 has the 1st receiving antenna 14 the 2nd receiving antenna 15 and the 3rd receiving antenna 16 and is constituted.

He is trying for MPU10 of the reader writer 5 for ID tags to acquire tag information based on the input signal from the receiving antennas 14-16 by connecting the antenna selected according to turning on and off of the switches 17a-17f with the corresponding receiving circuits 18-20.

[0007]

[Problem(s) to be Solved by the Invention] However in each composition mentioned above a receiving circuit increases and composition is complicated so that the number of receiving antennas increases from the necessity of providing a receiving circuit corresponding to each receiving antenna respectively.

[0008] From the strength of the noise level from the ambient environment which each receiving antenna receives by the installation operating environment of an antenna and an ID tag differing. Readjusted the threshold of the signal level for every receiving circuit in the installation site of the system or the installed environment of the customer needed to be changed and the work was very troublesome and large-sized-izing of the reader writer for ID tags and a high cost were invited.

[0009] In the composition provided with two or more receiving circuits in order to receive the signal from two or more receiving antennas by one reader writer for tags as especially mentioned above. The threshold for carrying out binarization of the input signal from a receiving antenna in a receiving circuit is unsuitable to the reader writer for ID tags of which a miniaturization and low cost are required [ in / adjustment is required respectively and / this point ] for every receiving circuit

according to the characteristic of each receiving antenna.

[0010] This invention was made in light of the above-mentioned circumstances and the purpose is to provide the reader/writer for ID tags which can simplify an entire configuration in the composition which acquires tag information from an ID tag based on the input signal from two or more receiving antennas.

[Means for Solving the Problem] According to the invention of claim 1, a widening rate decision means asking for a widening rate of a receiving circuit so that a signal level of an input signal from a receiving antenna selected in the state of the electric power supply to an ID tag may turn into the optimal receiving level, a widening rate setting-out means setting up a widening rate of a receiving circuit to become the widening rate which a widening rate decision means judged.

[0011] And since tag information is read in an ID tag where a widening rate of a receiving circuit is set up by a widening rate setting-out means, even though it changes a signal level of an input signal from a receiving antenna by switching a receiving antenna, an input signal can be widened at always optimal widening rate, and tag information can be certainly read in an ID tag.

[0012] According to the invention of claim 2, since a receiving level of a receiving circuit in a non-communication state with an ID tag is based on an environmental noise, it can ask for optimal reference level based on a receiving level for which a receiving level judging means asked.

[0013] And since tag information is read in an ID tag where reference level of a receiving circuit is set up by a reference level setting-out means, even though it changes a receiving level of an environmental noise, binarization of the input signal can be carried out with always optimal reference level, and tag information can be certainly read in an ID tag.

[0014] According to the invention of claim 3, since reference level which a reference level setting-out means set up by a reference level verifying means was checked, reference level can be set up certainly.

[0015]

[Embodiment of the Invention] (A 1st embodiment) A 1st embodiment that applied this invention to the lending management system of the library is hereafter described with reference to drawing 1 thru/or drawing 12.

[0016] Drawing 2 shows the entire configuration roughly. In this drawing 2, the shelf antennas 21-24 are arranged at the bookshelf-like storing case, and storage/exhibition of a book, the rental video, etc. is carried out on that shelf antenna 21-24. The ID tag is attached to such books and videotapes, and the book and rental video which are kept by the shelf are managed with an ID tag.

[0017] In the state where it was connected mutually, the above-mentioned shelf antennas 21-24 are connected with the controller (equivalent to the reader/writer for ID tags) 27, and each controller 27 acquires tag information from the ID tag located on each shelf antenna 21-24 by controlling the shelf antennas 21-24 in order.

according to the instructions from the host computer 28.

[0018] Here drawing 3 shows the connecting relation of the controller 27 and each shelf antennas 21–24. In this drawing 3 the fan antenna 24 etc. which suited the shape of the large-sized antenna 21 the medium size antenna 22 the small antenna 23 and the showcase as a shelf antenna according to the size of a shelf are installed suitably.

[0019] These shelf antennas 21–24 contain the transmission antenna 25 the receiving antenna 26 (refer to drawing 1) and a communication terminal and are constituted. In this case it has become as [ operate / the predetermined shelf antenna ] by choosing a communication terminal according to the instructions from the controller 27. That is the selected communication terminal transmits the signal for electric power to an ID tag from a transmission antenna according to the instructions from the controller 27 and it transmits the tag signal from the ID tag received with the receiving antenna to the controller 27.

[0020] Drawing 1 shows the composition of the controller 27 roughly. In this drawing 1 the controller 27 is constituted considering MPU29 as a subject and transmits the signal for electric power to ID tag 47 through the transmission antenna 25 from the sending circuit 30.

[0021] MPU (equivalent to widening rate decision means widening rate setting-out means receiving level judging means reference level setting-out means and reference level verifying means) 29 Tag information is acquired from an ID tag via the filter 31 the widening circuit 32 the rectification circuit 33 the detector circuit 34 (the above is equivalent to a receiving circuit) and the decode circuit 35.

[0022] Here the widening circuit 32 widens the input signal which passed the filter 31 and is constituted by the instructions from MPU29 so that change of the widening rate to an input signal is possible.

[0023] The detector circuit 34 changes into a binarization signal the input signal which passed through the rectification circuit 33 based on a threshold (reference level) and is constituted by the instructions from MPU29 so that change of a threshold is possible.

[0024] Drawing 4 shows the electric constitution of the widening circuit 32. In this drawing 4 the widening circuit 32 is constituted as a reversal widening circuit which made the operational amplifier 36 the subject and inputs into the non-inversed input terminal of the operational amplifier 36 the input signal which passed the filter 31. Between the non-inversed input terminal of this operational amplifier 36 and the output terminal two or more gain resistance 37–40 is connected in series and. Multiple connection of the switches 41–43 turned on and off by MPU29 is carried out to the gain resistance 38–40 of these gain resistance and as for resistance \*\*\*\*\* of the whole gain resistance the widening rate of the widening circuit 32 is adjusted according to turning on and off of each switches 41–43. In this case after all the switches 41–43 have turned off the widening rate of the widening circuit 32 becomes the lowest and this state is made into an initial state. The widening rate set up by one

of each switches 41–43 is controlled to become the optimal every antenna 21–24 so that it may mention later.

[0025]Drawing 5 shows the electric constitution of the detector circuit 34. In this drawing 5 the detector circuit 34 changes into a binarization signal with a comparator the light-receiving signal which passed through the rectification circuit 33.

[0026]That is the inversed input terminal of the operational amplifier 44 which makes the subject of a comparator is connected with the A/D input port of MPU29 and MPU29 is changed by the A/D converter which does not illustrate the output voltage from the rectification circuit 33.

[0027]The D/A output port of MPU29 is connected with the series circuit of the resistance 45 and the resistance 46 and MPU29 outputs prescribed voltage to the series circuit of the resistance 45 and the resistance 46 by the D/A converter which is not illustrated. The common node of the resistance 45 and the resistance 46 is connected with the non-inversed input terminal of the operational amplifier 44 and the voltage is set up as a threshold of a comparator. It is because it is made to correspond when MPU29 reduces the voltage from a D/A output port with the partial pressure of the resistance 45 and 46 since the threshold range of the operational amplifier 44 is smaller than the output voltage range from the D/A output port of MPU29 and this is set up.

[0028]The non-inversed input terminal of the operational amplifier 44 is connected with the A/D input port of MPU29 and MPU29 inputs the threshold of the operational amplifier 44 by the A/D converter which is not illustrated. This is for checking whether the threshold is a target threshold by detecting the threshold the partial pressure was carried out by the resistance 45 and 46 of.

[0029]On the other hand as shown in drawing 1 ID tag 47 has a resonant circuit which consists of the antenna 48 and the capacitor 49 it receives the signal for electric power transmitted from the transmission antenna 25 and generates the sending signal of predetermined frequency based on the signal for electric power and transmits. In this case when a question signal is included in the received signal for electric power ID tag 47 superimposes predetermined tag information on a sending signal and transmits to it.

[0030]Next an operation of the above-mentioned composition is explained. Now in the controller 27 since the input signal from two or more antennas 21–24 is widened by the one widening circuit 32 When the widening rate of the widening circuit 32 is fixed the signal level of an input signal shifts from the optimal level and it becomes impossible to analyze an input signal appropriately. Then the controller 27 was controlled so that an input signal served as the optimal level as follows.

[0031]Drawing 6 shows automatic setting operation of the widening rate of the widening circuit 32 in operation of MPU29. In this drawing 6 MPU29 switches the widening circuit 32 to an initial state first when reading tag information in ID tag 47 (S101). Thereby as shown in drawing 4 the switches 41–43 serve as OFF and the

widening rate of the widening circuit 32 serves as the minimum.

[0032] Then MPU29 chooses a predetermined shelf antenna from among the shelf antennas 21–24 (S102) and transmits the signal for electric power from the transmission antenna 25 (S103). Thereby since the signal for electric power is transmitted to ID tag 47 from the transmission antenna 25 from ID tag 47 the signal according to the frequency of the signal for electric power is transmitted. At this time tag information is not included in the sending signal from ID tag 47.

[0033] Then MPU29 inputs the signal level of the input signal from ID tag 47 from an A/D input port (S104) and judges the widening rate of the widening circuit 32 based on the input level (S105). That is it judges that it is set to the ideal signal level outputted from the widening circuit 32 by the widening rate of the widening circuit 32. In this case since the signal level of the input signal from ID tag 47 shows the characteristic which becomes small and is set to “1” with the large-sized antenna 21 so that the shape of a shelf antenna becomes large if the ideal signal level outputted from the widening circuit 32 is set to “10” it is necessary to set up the widening rate of the widening circuit 32 10 times.

[0034] Therefore MPU29 adjusts the resistance of the whole gain resistance of the widening circuit 32 by switching each switches 41–43 so that the widening rate of the widening circuit 32 may be abbreviated 10 times (S106).

[0035] Similarly each antennas 21–24 are chosen in order and where the optimal widening rate according to the selected antenna is set as the widening circuit 32 tag information is read in ID tag 47 through each antennas 21–24. That is according to the signal level of an input signal being “2” when reading tag information in ID tag 47 through the medium size antenna 22 as shown in drawing 7 a widening rate is set as “5” According to the signal level of an input signal being “5” when reading tag information in ID tag 47 through the small antenna 23 a widening rate is set as “2” When reading tag information in ID tag 47 through the fan antenna 24 according to the signal level of an input signal being “3” a widening rate is set as “3.3.”

[0036] By the way as shown in drawing 8 when the threshold in the detector circuit 34 is larger enough than a noise level and smaller enough than the high-level fluctuation range of a signal level In the detector circuit 34 it receives that binarization of the input signal can be carried out without being influenced by a noise As shown in drawing 9 the threshold in the detector circuit 34 cannot be smaller than a noise level or as shown in drawing 10 when a threshold is larger than a signal level binarization of the input signal cannot be carried out correctly.

[0037] In this case since the characteristics of each antennas 21–24 differ and the noise levels received also to the same environmental noise differ the noise levels widened in the widening circuit 32 differ for every antenna. For this reason when binarization was carried out with the threshold which fixed the input signal in the detector circuit 34 it enabled it to change an input signal into a binarization signal correctly as follows from it becoming impossible to change an input signal into a

binarization signal correctly according to fault which was mentioned above.

[0038]Drawing 11 is a flow chart which shows threshold setting operation of MPU29. In this drawing 11 MPU29 carries out prescribed frequency execution of the operation of inputting the received signal level in (S201) and a non communication state with ID tag 47 from an A/D port when the shelf antennas 21-24 are chosen (S202S203).

[0039]At this time the receiving antenna 26 of the selected antenna has received the environmental noise and since the received signal level for which it asked as mentioned above shows the size of the environmental noise MPU29 calculates a threshold based on a noise level (S204).

[0040]And MPU29 outputs prescribed voltage from a D/A port as a predetermined threshold is outputted to the detector circuit 34 by the partial pressure by the resistance 45 and 46 (S205).

[0041]Here MPU29 inputs the threshold of the detector circuit 34 from an A/D port (S206) it checks whether the inputted threshold has exceeded the target threshold (S207) and when not having exceeded only a predetermined level increases the output voltage from a D/A output port (S208).

[0042]And when the threshold of the detector circuit 34 comes to exceed a predetermined level (S207: YES) and its output state are maintained. The suitable threshold according to the size of the environmental noise to the shelf antennas 21-24 is set up as a result of the above operation.

[0043]That is as shown in drawing 12 when the noise level of the large-sized antenna 21 is "5" it is controlled so that the threshold of the detector circuit 34 is set to "6." When the noise level of the medium size antenna 22 is "4" the threshold of the detector circuit 34 is controlled to be set to "5." When the noise level of the small antenna 23 is "3" the threshold of the detector circuit 34 is controlled to be set to "4." And when the noise level of the fan antenna 24 is "2" the threshold of the detector circuit 34 is controlled to be set to "3."

[0044]Now when the widening rate of the widening circuit 32 and the threshold of the detector circuit 34 are set up corresponding to the shelf antennas 21-24 chosen as were mentioned above MPU29 transmits where a question signal is superimposed on the signal for electric power from the transmission antenna 25 of the selected antenna. Thereby since ID tag 47 transmits tag information after even the optimal level widens the input signal from ID tag 47 in the widening circuit 32 MPU29 can read the tag information from ID tag 47 certainly by carrying out binarization with the optimal threshold in the detector circuit 34.

[0045]Therefore the host computer 28 can manage the book or video currently kept based on the tag information from ID tag 47 located on the shelf antenna 21-24 through each controller 27.

[0046]When communicating with ID tag 47 through the predetermined shelf antennas 21-24 according to such an embodiment Since tag information was read in ID tag 47 where gain resistance of the widening circuit 30 is switched so that it might become



the optimal widening rate corresponding to the shelf antennas 21-24 as a widening rate of the widening circuit 30. Irrespective of the characteristic of the shelf antennas 21-24, an input signal can be widened so that it may be set to the optimal level.

[0047] Since it was made to carry out binarization of the input signal in the state where it set up exceed the threshold in the detector circuit 34 rather than a noise level, binarization of the input signal can be carried out without being influenced by an environmental noise. Therefore, tag information can be certainly read in an ID tag irrespective of a difference of the characteristic of the shelf antennas 21-24 or the size of an environmental noise.

[0048] (A 2nd embodiment) Drawing 13 shows a 2nd embodiment of this invention. This 2nd embodiment was applied to the composition which equipped one antenna with two or more receiving antennas.

[0049] Namely, in drawing 13 in which an entire configuration is shown roughly, the antenna 51 combines the 1st antenna section 52, the 2nd antenna section 53, and the 3rd antenna section 54. Corresponding to the transmission antenna which is not illustrated, the three receiving antennas 52a are formed in the 1st antenna section 52. Corresponding to the transmission antenna which is not illustrated, the two receiving antennas 53a are formed in the 2nd antenna section 53, and the one receiving antenna 54a is formed in the 3rd antenna section 54 corresponding to the transmission antenna which is not illustrated. And the switches 55-57 which consist of a relay or a photo thyristor corresponding to each antenna sections 52-54 are formed, and when the switches 55-57 are turned on and off by the controller 27, the predetermined antenna sections 52-54 are chosen and it operates.

[0050] In this case, since each antenna sections 52-54 differ also in the noise level which the characteristics differ and suitable widening rates differ for every receiving antenna, with selected one of the switches 55-57 and is received. In the widening circuit 30 of the controller 27, the optimal widening rate is set up automatically corresponding to the receiving antenna 26.

[0051] The threshold in the detector circuit 34 is set automatically as the intermediate level of a noise level and a signal level. That is, in addition to a noise level, also take into consideration the signal level of the input signal from ID tag 47, set up the threshold of the detector circuit 34 and as a threshold in the detector circuit 34. When a noise level is "2" and a signal level is "5" in the 1st antenna section 52a, threshold is set as "4." When a noise level is "2" and a signal level is "4" in the 2nd antenna section 53a, threshold is set as "3." And when a noise level is "2" and a signal level is "3" in the 3rd antenna section 54a, threshold is set as "2.5."

[0052] Since the threshold in the detector circuit 34 was set as the intermediate level of a noise level and a signal level according to such an embodiment, tag information can be certainly read in ID tag 43 without receiving the influence of change of an environmental noise or a received signal level.

[0053] (A 3rd embodiment) Drawing 14 shows a 3rd embodiment of this invention. This

3rd embodiment is having applied the large-sized antenna which has the same characteristic to the composition mutually connected like a 1st embodiment.

[0054] Namely as an entire configuration is shown in drawing 14 shown roughly even if it is the composition of connecting two or more large-sized antennas 21 of identical property and inputting the input signal from ID tag 47. Depending on the arrangement state of existence of a noise source, existence of metal or ID tag 47. In the composition using two or more large-sized antennas 21 of identical property since the noise level or the received signal level from ID tag 47 which the receiving antenna 26 receives is different. It is made to set up in the middle of a noise level and a received signal level as a threshold in the detector circuit 34 like a 2nd embodiment.

[0055] Since the characteristic of the large-sized antenna 21 is the same in usual noise level. In this case, if the noise source of what is "7" is in the large-sized antenna 21 which exists in the neighborhood since the noise level is higher than "5" and usual received signal level sets up "6" as a threshold. If metal is in the large-sized antenna which exists in the neighborhood since the received signal level is lower than "4" and usual is set up as a threshold. If it is in a normal large-sized antenna, is set up as a threshold. And if it is in the large-sized antenna 21 which ID tag 47 inclines and exists since the received signal level is lower than "4" and usual is set up as a threshold.

[0056] Since the threshold in a detector circuit was set as the intermediate level of a noise level and a received signal level in the composition using two or more antennas of identical property according to such an embodiment. The tag information from ID tag 47 can be certainly read like a 2nd embodiment without receiving the influence of change of an environmental noise and a received signal level.

[0057] This invention is not limited to each above-mentioned embodiment and can be transformed or extended as follows. It may be made to perform either one of the automatic regulation of a widening rate in a widening circuit and an automatic regulation of the threshold of the comparator in a detector circuit. It may be made to perform an automatic regulation of the threshold of the comparator in an automatic regulation and detector circuit of the widening rate in a widening circuit periodically.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The block diagram showing the whole composition for a 1st embodiment of this invention

[Drawing 2] The figure showing the whole connecting relation

[Drawing 3] The figure showing the connecting relation of a controller and each shelf antenna

[Drawing 4] The electric diagram showing the composition of a widening circuit

[Drawing 5]The electric diagram showing the composition of a detector circuit

[Drawing 6]The flow chart which shows operation of the widening circuit by MPU

[Drawing 7]The figure showing the relation between the signal level for every antenna and a widening rate

[Drawing 8]The figure showing the state where the received signal level has exceeded the noise level

[Drawing 9]The figure showing the state where the noise has exceeded the threshold

[Drawing 10]The figure showing the state where the input signal is less than the threshold

[Drawing 11]The flow chart which shows operation of MPU

[Drawing 12]The figure showing the relation between the noise level for every antenna and a threshold

[Drawing 13]The drawing 3 equivalent figure showing a 2nd embodiment of this invention

[Drawing 14]The drawing 3 equivalent figure showing a 3rd embodiment of this invention

[Drawing 15]The drawing 3 equivalent figure showing a conventional example

[Drawing 16]The drawing 3 equivalent figure showing other conventional examples

[Description of Notations]

21-24 a shelf antenna and 25 a transmission antenna and 26 A receiving antenna 27 -  
 - a controller (reader writer for ID tags) and 29 -- MPU (a widening rate decision means.) A widening rate setting-out means a receiving level judging means a reference level setting-out means a reference level verifying means 32 -- a widening circuit (receiving circuit) and 34 -- as for a switch and 44 an operational amplifier and 37-40 are [ resistance and 47 ] ID tags an operational amplifier and 45 and 46 gain resistance and 41-43 a detector circuit (receiving circuit) and 36.

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